INSTRUCTOR'S SOLUTIONS MANUAL

GAIL ILLICH
McLennan Community College

PAUL ILLICH
Southeast Community College

STATISTICS FOR MANAGERS
USING MICROSOFT® EXCEL®
NINTH EDITION

David Levine
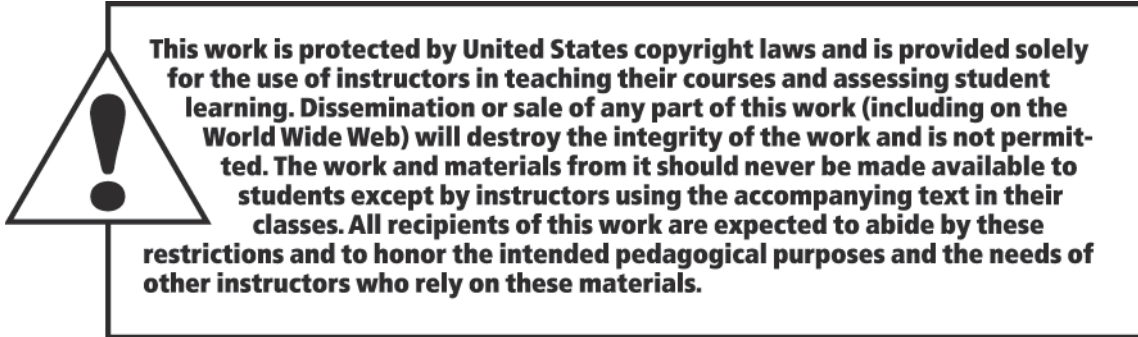
Baruch College, City University of New York

David Stephan

Two Bridges Instructional Technology

Kathryn Szabat

La Salle University

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Preface

The first part of the ***Instructor's Solutions Manual*** contains our educational philosophy and teaching tips for each chapter of the text. Solutions to End-of-Section Problems and Chapter Review Problems in each chapter follow. Instructional tips and solutions for the digital cases are included next. Answers to the *Brynne Packaging* Case, the *CardioGood Fitness* Case, the *Choice Is Yours/More Descriptive Choices Follow-up Case*, the *Clear Mountain State Student Surveys Case,* the *Craybill Instrumentation Company* Case, the *Managing Ashland MultiComm Services* Case, the *Mountain States Potato Company Case* and the *Sure Value Convenience Stores* Case are included last.

The purpose of this ***Instructor's Solutions Manual*** is to facilitate grading of assignments or exams by instructors and/or teaching assistants. Screen shots using output from PHStat are integrated throughout. Most of the problems are solved using PHStat. To present the steps involved in solving a problem, some intermediate numerical results are presented accurate to only a reasonable number of significant digits. Hence, instructors are reminded that the final results presented in this manual that are obtained using PHStat can sometimes be different from those obtained with a hand calculator computed using the intermediate values due to rounding.

Teaching Tips for

Statistics for Managers using Microsoft® Excel 9th Ed.

Our Starting Point

Over a generation ago, advances in "data processing" led to new business opportunities as first centralized and then desktop computing proliferated. The Information Age was born. Computer science became much more than just an adjunct to a mathematics curriculum, and whole new fields of studies, such as computer information systems, emerged.

More recently, further advances in information technologies have combined with data analysis techniques to create new opportunities in what is more data *science* than data *processing* or *computer* science. The world of business statistics has grown larger, bumping into other disciplines. And, in a reprise of something that occurred a generation ago, new fields of study, this time with names such as informatics, data analytics, and decision science, have emerged.

This time of change makes what is taught in business statistics and how it is taught all the more critical. These new fields of study all share statistics as a foundation for further learning. We are accustomed to thinking about change, as seeking ways to continuously improve the teaching of business statistics have always guided our efforts. We actively participate in Decision Sciences Institute (DSI), American Statistical Association (ASA), and Making Statistics More Effective in Schools and Business (MSMESB) conferences. We use the ASA's Guidelines for Assessment and Instruction (GAISE) reports and combine them with our experiences teaching business statistics to a diverse student body at several large universities.

What to teach and how to teach it are particularly significant questions to ask during a time of change. As an author team, we bring a unique collection of experiences that we believe helps us find the proper perspective in balancing the old and the new. Our lead author, David M. Levine, was the first educator, along with Mark L. Berenson, to create a business statistics textbook that discussed using statistical software and incorporated "computer output" as illustrations—just the first of many teaching and curricular innovations in his many years of teaching business statistics. Our second author, David F. Stephan, developed courses and teaching methods in computer information systems and digital media during the information revolution, creating, and then teaching in, one of the first personal computer *classrooms* in a large school of business along the way. Early in his career, he introduced spreadsheet applications to a business statistics faculty audience that included David Levine, an introduction that would eventually led to the first edition of this textbook. Our newest co-author, Kathryn A. Szabat, has provided statistical advice to various business and non-business communities. Her background in

statistics and operations research and her experiences interacting with professionals in practice have guided her, as departmental chair, in developing a new, interdisciplinary academic department, Business Systems and Analytics, in response to the technology- and data-driven changes in business today.

All three of us benefit from our many years teaching undergraduate business subjects and the diversity of interests and efforts of our past co-authors, Mark Berenson and Timothy Krehbiel. Two of us (Stephan and Szabat) also benefit from formal training and background in educational methods and instructional design.

Educational Philosophy

As in prior editions of *Statistics for Managers Using Microsoft Excel*, we are guided by these key learning principles:

1. **Help students see the relevance of statistics to their own careers by providing examples drawn from the functional areas in which they may be specializing.** Students need a frame of reference when learning statistics, especially when statistics is not their major. That frame of reference for business students should be the functional areas of business, such as accounting, finance, information systems, management, and marketing. Each statistics topic needs to be presented in an applied context related to at least one of these functional areas. The focus in teaching each topic should be on its application in business, the interpretation of results, the evaluation of the assumptions, and the discussion of what should be done if the assumptions are violated.

2. **Emphasize interpretation of statistical results over mathematical computation.** Introductory business statistics courses should recognize the growing need to *interpret* statistical results that computerized processes create. This makes the interpretation of results more important than knowing how to execute the tedious hand calculations required to produce them.

3. **Give students ample practice in understanding how to apply statistics to business.** Both classroom examples and homework exercises should involve actual or realistic data as much as possible. Students should work with data sets, both small and large, and be encouraged to look beyond the statistical analysis of data to the interpretation of results in a managerial context.

4. **Familiarize students with how to use statistical software to assist business decision-making.** Introductory business statistics courses should recognize that programs with statistical functions are commonly found on a business decision maker's desktop computer. Integrating statistical software into all aspects of an introductory statistics course allows the course to focus on interpretation of results instead of computations (see point 2).

5. **Provide clear instructions to students for using statistical applications.** Books should explain clearly how to use programs such as Microsoft Excel with the study of statistics, without having those instructions dominate the book or distract from the learning of statistical concepts.

4   Teaching Tips

First Things First

In a time of change, you can never know exactly what knowledge and background students bring into an introductory business statistics classroom. Add that to the need to curb the fear factor about learning statistics that so many students begin with, and there's a lot to cover even before you teach your first statistical concept.

We created "First Things First" to meet this challenge. This unit sets the context for explaining what statistics is (not what students may think!) while ensuring that all students share an understanding of the forces that make learning business statistics critically important today. Especially designed for instructors teaching with course management tools, including those teaching hybrid or online courses, "First Things First" has been developed to be posted online or otherwise distributed before the first class section begins and is available from the download page for this book that is discussed in Appendix Section C.1.

We would argue that the most important class is the first class. First impressions are critically important. You have the opportunity to set the tone to create a new impression that the course will be important to their business education. Make the following points:

- This course is not a math course.
- State that you will be learning analytical skills for making business decisions.
- Explain that the focus will be on how statistics can be used in the functional areas of business.

This book uses a systematic approach for meeting a business objective or solving a business problem. This approach goes across all the topics in the book and most importantly can be used as a framework in real world situations when students graduate. The approach has the acronym **DCOVA**, which stands for **D**efine, **C**ollect, **O**rganize, **V**isualize, and **A**nalyze.

- **D**efine the business objective or problem to be solved and then define the variables to be studied.
- **C**ollect the data from appropriate sources
- **O**rganize the data
- **V**isualize the data by developing charts
- **A**nalyze the data by using statistical methods to reach conclusions.

To this, you can add **C** for Communicate which is critically important

You can begin by emphasizing the importance of defining your objective or problem. Then, discuss the importance of operational definitions of variables to be considered and define variable, data, and statistics.

Just as computers are used not just in the computer course, students need to know that statistics is used not just in the statistics course. This leads you to a discussion of business analytics in which data is

used to make decisions. Make the point that analytics should be part of the competitive strategy of every organization especially since "big data" meaning data collected in huge volumes at very fast rates. needs to be analyzed.

Inform the students that there is an Excel Guide at the end of each chapter. Strongly encourage or require students to read the Excel Guide at the end of this chapter so that they will be ready to use Excel with this book.

Chapter 1

You need to continue the discussion of the Define task by establishing the types of variables. Be sure to discuss the different types carefully since the ability to distinguish between categorical and numerical data will be crucial later in the course. Go over examples of each type of variable and have students provide examples of each type. Then, if you wish, you can cover the different measurement scales.

Then move on to the C of the DCOVA approach, collecting data. Mention the different sources of data and make sure to cover the fact that data often needs to be cleaned of errors.

Then, you could spend some time discussing sampling, you may want to take a bit more time and discuss the types of survey sampling methods and issues involved with survey sampling results. The *Consider This* essay discusses the important issue of the use of Web-based surveys.

The chapter also introduces two continuing cases related to *Managing Ashland MultiComm Services* and *CardioGood Fit*ness that appear at the end of many chapters. The Digital cases are introduced in this chapter also. In these cases, students visit Web sites related to companies and issues raised in the Using Statistics scenarios that start each chapter. The goal of the Digital cases is for students to develop skills needed to identify misuses of statistical information. As would be the situation with many real world cases, in Digital cases, students often need to sift through claims and assorted information in order to discover the data most relevant to a case task. They will then have to examine whether the conclusions and claims are supported by the data. (Instructional tips for using the *Managing Ashland MultiComm Services* and Digital cases and solutions to the *Managing Ashland MultiComm Services* and Digital cases are included in this *Instructor's Solutions Manual*.).

Make sure that students read the Excel Guide at the end of each chapter. Ways of Working With Excel on pages 7 and 8 explains the different type of Excel instructions. The *Workbook* instructions provide step-by-step instructions and live worksheets that automatically update when data changes. The *PHStat2 add-in* instructions provide instructions for using the PHStat2 add-in. *Analysis ToolPak* instructions provide instructions for using the Analysis ToolPak, the Excel add-in package that is included with many versions of Excel.

Chapter 2

This chapter moves on to the organizing and visualizing steps of the DCOVA framework. If you are going to collect sample data to use in Chapters 2 and 3, you can illustrate sampling by conducting a survey of students in your class. Ask each student to collect his or her own personal data concerning the time it takes to get ready to go to class in the morning or the time it takes to get to school or home from school. First, ask the students to write down a definition of how they plan to measure this time. Then, collect the various answers and read them to the class. Then, a single definition could be provided (such as the time to get ready is the time measured from when you get out of bed to when you leave your home, recorded to the nearest minute). In the next class, select a random sample of students and use the data collected (depending on the sample size) in class when Chapters 2 and 3 are discussed.

Then, move on to the Organize step that involves setting up your data in an Excel worksheet and develop tables to help you prepare charts and analyze your data. Begin your discussion for categorical data with the example on p. 34 concerning how people pay for purchases and other transactions. Show the summary table and then if you wish, explain that you can sometimes organize the data into a two-way table that has one variable in the row and another in the column.

Continue with organizing data (but now for numerical data) by referring to the cost of a restaurant meal on p. 38. Show the simple ordered array and how a frequency distribution, percentage distribution, or cumulative distribution can summarize the raw data in a way that is more useful.

Now you are ready to tackle the Visualize step. A good way of starting this part of the chapter is to display the following quote.

<div style="text-align:center">"A picture is worth a thousand words."</div>

Students will almost certainly be familiar with Microsoft$^{®}$ Word and may have already used Excel to construct charts that they have pasted into Word documents. Now you will be using Excel to construct many different types of charts. Return to the purchase payment data previously discussed and illustrate how a bar chart, pie, and doughnut chart can be constructed using Excel. Mention the advantages and disadvantages of each chart. A good example is to show the data on incomplete ATM transactions on p. 49 and how the Pareto chart enables you to focus on the vital few categories. If time permits, you can discuss the side-by-side bar chart for a contingency table.

To examine charts for numerical variables you can either use the restaurant data previously mentioned, the retirement funds data, or data that you have collected from your class. You may want to begin with a simple stem-and-leaf display that both organizes the data and shows a bar type chart. Then move on to the histogram and the various polygons, pointing out the advantages and disadvantages of each.

If time permits, you can discuss the scatter plot and the time-series plot for two numerical variables. Otherwise, you can wait until you get to regression analysis. If you cover the time series plot, you might also want to mention sparklines that are discussed in Section 2.6.

Also, if possible, you may want to discuss how multidimensional tables allow you to drill down to individual cells of the table. You can follow this with further discussion of PivotTables and Excel slicers that enable you to see panels for each variable being studied.

If the opportunity is available, we believe that it is worth the time to cover Section 2.7 on Challenges in Organizing and Visualizing Variables. This is a topic that students very much enjoy since it allows for a great deal of classroom interaction. After discussing the fundamental principles of good graphs, try to illustrate some of the improper displays shown in Figures 2.26 – 2.28. Ask students what is "bad" about these figures. Follow up with a homework assignment involving Problems 2.69 – 2.73 (*USA Today* is a great source).

You will find that the chapter review problems provide large data sets with numerous variables. Report writing exercises provide the opportunity for students to integrate written and or oral presentation with the statistics they have learned.

The *Managing Ashland MultiComm Services* case enables students to examine the use of statistics in an actual business environment. The Digital case refers to the EndRun Financial Services and claims that have been made. The CardioGood Fitness case focuses on developing a customer profile for a market research team. The Choice Is Yours Follow-up expands on the chapter discussion of the mutual funds data. The Clear Mountain State Student Survey provides data collected from a sample of undergraduate students.

The Excel Guide for this and the remaining chapters are organized according to the sections of the chapter. It is quite extensive since it covers both organizing and visualizing many different graphs. The Excel Guide includes instructions for Workbook, PHStat2, and the Analysis ToolPak.

Chapter 3

This chapter on descriptive numerical statistical measures represents the initial presentation of statistical symbols in the text. Students who need to review arithmetic and algebraic concepts may wish to refer to Appendix A for a quick review or to appropriate texts (see **www.pearson.com**) or videos (**www.videoaidedinstruction.com**). Once again, as with the tables and charts constructed for numerical data, it is useful to provide an interesting set of data for classroom discussion. If a sample of students was selected earlier in the semester and data concerning student time to get ready or commuting time was collected (see Chapters 1 and 2), use these data in developing the numerous descriptive summary measures in this chapter. (If they have not been developed, use other data for classroom illustration.)

Discussion of the chapter begins with the property of central tendency. We have found that almost all students are familiar with the arithmetic mean (which they know as the average) and most students are familiar with the median. A good way to begin is to compute the mean for your classroom example. Emphasize the effect of extreme values on the arithmetic mean and point out that the mean is like the center of a seesaw -- a balance point. Note that you will return to this concept later when you discuss the variance and the standard deviation. You might want to introduce summation notation at this point and express the arithmetic mean in formula notation as in Equation (3.1). (Alternatively, you could wait until you cover the variance and standard deviation.) A classroom example in which summation notation is reviewed is usually worthwhile. Remind the students again that Appendix A includes a review of arithmetic and algebra and summation notation [or refer them to other text sources such as those found at **www.pearson.com** or videos (see **www. videoaidedinstruction.com**)].

The next statistic to compute is the median. Be sure to remind the students that the median as a measure of position must have all the values ranked in order from lowest to highest. Be sure to have the students compare the arithmetic mean to the median and explain that this tells us something about another property of data (skewness). Following the median, the mode can be briefly discussed. Once again, have the students compare this result to those of the arithmetic mean and median for your data set. If time permits, you can also discuss the geometric mean which is heavily used in finance.

The completion of the discussion of central tendency leads to the second characteristic of data, variability. Mention that all measures of variation have several things in common: (1) they can never be negative, (2) they will be equal to 0 when all items are the same, (3) they will be small when there isn't much variation, and (4) they will be large when there is a great deal of variation.

The first measure of variability to consider is the simplest one, the range. Be sure to point out that the range only provides information about the extremes, not about the distribution between the extremes.

Point out that the range lacks one important ingredient, the ability to take into account each data value. Bring up the idea of computing the differences around the mean, but then return to the fact that as the balance point of the seesaw, these differences add up to zero. At that point, ask the students what they can do mathematically to remove the negative sign for some of the values. Most likely, they will answer by telling you to square them (although someone may realize that the absolute value could be taken). Next, you may want to define the squared differences as a sum of squares. Now you need to have the students realize that the number of values being considered affects the magnitude of the sum of squared differences. Therefore, it makes sense to divide by the number of values and compute a measure called the variance. If a population is involved, you divide by N, the population size, but if you are using a sample, you divide by n - 1, to make the sample result a better estimate of the population variance. You can finish the development of variation by noting that since the variance is in squared units, you need to take the square root to compute the standard deviation.

Another measure of variation that can be discussed is the coefficient of variation. Be sure to illustrate the usefulness of this as a measure of relative variation by using an example in which two data sets have vastly different standard deviations, but also vastly different means. A good example is one that involves the volatility of stock prices. Point out that the variation of the price should be considered in the context of the magnitude of the arithmetic mean. The final measure of variation is the Z score. Point out that this provides a measure of variation in standard deviation units. You can also say that you will return to Z scores in Chapter 6 when the normal distribution will be discussed.

You are now ready to move on to the third characteristic of data, shape. Be sure to clearly define and illustrate both symmetric and skewed distributions by comparing the mean and median. You may also want to briefly mention the property of kurtosis which is the relative concentration of values in the center of the distribution as compared to the tails. This statistic is provided by Excel through an Excel function or the Analysis Toolpak.

Once these three characteristics have been discussed, you are ready to show how they can be computed using Excel.

Now that these measures are understood, you can further explore data by computing the quartiles, the interquartile range, the five number summary, and constructing a boxplot. You begin by determining the quartiles. Reference here can be made to the standardized exams that students have taken, and the quantile scores that they have received (97th percentile, 48th percentile, 12th percentile, etc.). Explain that the 1st and 3rd quartiles are merely two special quantiles -- the 25th and 75th, that unlike the median (the 2nd quartile), are not at the center of the distribution.   Once the quartiles have been computed, the interquartile range can be determined. Mention that the interquartile range computes the variation in the center of the distribution as compared to the difference in the extremes computed by the range.

You can then discuss the five-number summary of minimum value, first quartile, median, third quartile, and maximum value. Then, you construct the boxplot. Present this plot from the perspective of serving as a tool for determining the location, variability, and symmetry of a distribution by visual inspection, and as a graphical tool for comparing the distribution of several groups. It is useful to display Figure 3.6 on page 118 that indicates the shape of the boxplot for four different distributions. Then, use PHStat2 to construct a boxplot. Note that you can construct the boxplot for a single group or for multiple groups.
If you desire, you can discuss descriptive measures for a population and introduce the empirical rule and the Chebyshev rule.

If time permits, and you have covered scatter plots in Chapter 2, you can briefly discuss the covariance and the coefficient of correlation as a measure of the strength of the association between two numerical variables. Point out that the coefficient of correlation has the advantage as compared to the covariance of being on a scale that goes from -1 to +1. Figure 3.9 on p. 127 is useful in depicting scatter plots for different coefficients of correlation.

Once again, you will find that the chapter review problems provide large data sets with numerous variables.

The *Managing Ashland MultiComm Services* case enables students to examine the use of descriptive statistics in an actual business environment. The Digital case continues the evaluation of the EndRun Financial Services discussed in the Digital case in Chapter 2. The CardioGood Fitness case focuses on developing a customer profile for a market research team. More Descriptive Choices Follow-up expands on the discussion of the mutual funds data. The Clear Mountain State Student Survey provides data collected from a sample of undergraduate students.

The Excel Guide for the chapter includes instructions on using different Excel functions to compute various statistics. Alternatively, you can use PHStat or the Analysis ToolPak to compute a list of statistics. PHStat2 can be used to construct a boxplot.

Chapter 4

The chapter on probability represents a bridge between the descriptive statistics already covered and the topics of statistical inference, regression, time series, and business analytics to be covered in subsequent chapters. In many traditional statistics courses, often a great deal of time is spent on probability topics that are of little direct applicability in basic statistics. The approach in this text is to cover only those topics that are of direct applicability in the remainder of the text.

You need to begin with a relatively concise discussion of some probability rules. Essentially, students really just need to know that (1) no probability can be negative, (2) no probability can be more than 1, and (3) the sum of the probabilities of a set of mutually exclusive events adds to 1.0. Students often understand the subject best if it is taught intuitively with a minimum of formulas, with an example that relates to a business application shown as a two-way contingency table (see the Using Statistics example). If desired, you can use the Excel Workbook instructions or PHStat2 to compute probabilities from the contingency table.

Once these basic elements of probability have been discussed, if there is time and you desire, conditional probability and Bayes' theorem (an online topic) can be covered. The *Consider This* concerning email SPAM is a wonderful way of helping students realize the application of probability to everyday life. Be aware that in a one-semester course where time is particularly limited, these topics may be of marginal importance. The Digital case in this chapter extends the evaluation of the EndRun Financial Services to consider claims made about various probabilities. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve developing contingency tables to be able to compute and interpret conditional and marginal probabilities.

Chapter 5

Now that the basic principles of probability have been discussed, the probability distribution is developed and the expected value and variance (and standard deviation) are computed and interpreted. Given that a probability distribution has been defined, you can now discuss some specific distributions. Although every introductory course undoubtedly covers the normal distribution to be discussed in Chapter 6, the decision about whether to cover the binomial, Poisson, or hypergeometric distributions is matter of personal choice and depends on whether the course is part of a two-course sequence.

If the binomial distribution is covered, an interesting way of developing the binomial formula is to follow the Using Statistics example that involves an accounting information system. Note, in this example, the value for p is 0.10. (It is best not to use an example with $p = 0.50$ since this represents a special case). The discussion proceeds by asking how you could get three tagged order forms in a sample of 4. Usually a response will be elicited that provides three items of interest out of four selections in a particular order such as Tagged Tagged Not Tagged Tagged. Ask the class, what would be the probability of getting Tagged on the first selection? When someone responds 0.1, ask them how they found that answer and what would be the probability of getting Tagged on the second selection. When they answer 0.1 again, you will be able to make the point that in saying 0.1 again, they are assuming that the probability of Tagged stays constant from trial to trial. When you get to the third selection and the students respond 0.9, point out that this is a second assumption of the binomial distribution -- that only two outcomes are possible -- in this case Tagged and Not Tagged, and the sum of the probabilities of Tagged and Not Tagged must add to 1.0. Now you can compute the probability of three out of four in *this* order by multiplying (0.1)(0.1)(0.9)(0.1) to get 0.0009. Ask the class if this is the answer to the original question. Point out that this is just one way of getting three Tagged out of four selections in a specific order, and, that there are four ways to get three Tagged out of four selections. This leads to the development of the binomial formula Equation (5.5). You might want to do another example at this point that calls for adding several probabilities such as three or more Tagged, less than three Tagged, etc. Complete the discussion of the binomial distribution with the computation of the mean and standard deviation of the distribution. Be sure to point out that for samples greater than five, computations can become unwieldy and the student should use PHStat2, an Excel function, or the binomial tables (See the Online **Binomial.pdf** tables).

Once the binomial distribution has been covered, if time permits, other discrete probability distributions can be presented. If you cover the Poisson distribution, point out the distinction between the binomial and Poisson distributions. Note that the Poisson is based on an area of opportunity in which you are counting occurrences within an area such as time or space. Contrast this with the binomial distribution

in which each value is classified as of interest or not of interest. Point out the equations for the mean and standard deviation of the Poisson distribution and indicate that the mean is equal to the variance. Since the computation of probabilities from these discrete probability distributions can become tedious for other than small sample sizes, it is important to discuss PHStat2, an Excel function or the Poisson tables (See the Online **Poisson.pdf** tables).

If you so desire, you can discuss the covariance of a probability distribution (online Section 5.4), which is of particular importance to students majoring in finance. It is referred to in various finance courses including those on portfolio management and corporate finance. Use the example in the text to illustrate the covariance. If desired, continue with coverage of portfolio expected return and portfolio risk. Note that the PHStat2 Covariance and Portfolio Management menu selection allows you to readily compute the pertinent statistics. It also allows you to demonstrate changes in either the probabilities or the returns and their effect on the results. If you are using Workbook, you can start with the Portfolio.xls workbook and show how various Excel functions can be used to compute the desired statistics.

The hypergeometric distribution (online Section 5.5) can be developed for the situation in which one is sampling without replacement. Once again, use PHStat2 or an Excel function.

The *Managing Ashland MultiComm Services* case for this chapter relates to the binomial distribution. The Digital case involves the expected value and standard deviation of a probability distribution and applications of the covariance in finance.

Chapter 6

Now that probability and probability distributions have been discussed in Chapters 4 and 5, you are ready to introduce the normal distribution. We recommend that you begin by mentioning some reasons that the normal distribution is so important and discuss several of its properties. We would also recommend that you do not show Equation (6.1) in class as it will just intimidate some students. You might begin by focusing on the fact that any normal distribution is defined by its mean and standard deviation and display Figure 6.3 on p. 193. Then, an example can be introduced and you can explain that if you subtracted the mean from a particular value, and divided by the standard deviation, the difference between the value and the mean would be expressed as a standardized normal or Z score that was discussed in Chapter 3. Next, use Table E.2, the cumulative normal distribution, to find probabilities under the normal curve. In the text, the cumulative normal distribution is used since this table is consistent with results provided by Excel. Make sure that all the students can find the appropriate area under the normal curve in their cumulative normal distribution tables. If anyone cannot, show them how to find the correct value. Be sure to remind the class that since the total area under the curve adds to 1.0, the word area is synonymous with the word probability. Once this has been accomplished, a good approach is to work through a series of examples with the class, having a different student explain how to find each answer. The example that will undoubtedly cause the most difficulty will be finding the values corresponding to known probabilities. Slowly go over the fact that in this type of example, the probability is known and the Z value needs to be determined, which is the opposite of what the student has done in previous examples. Also point out that in cases in which the unknown X value is below the mean, the negative sign must be assigned to the Z value. Once the normal distribution has been covered, you can use PHStat2, or various Excel functions to compute normal probabilities. You can also use the Visual Explorations in Statistics Normal distribution procedure on p. 199. This will be useful if you intend to use examples that explore the effect on the probabilities obtained by changing the X value, the population mean, μ, or the standard deviation, σ. The *Consider This* essay provides a historical perspective of the application of the normal distribution.

If you have sufficient time in the course, the normal probability plot can be discussed. Be sure to note that all the data values need to be ranked in order from lowest to highest and that each value needs to be converted to a normal score. Again, you can either use PHStat2 to generate a normal probability plot or use Excel functions and charts.

If time permits, you may want to cover the uniform distribution and refer to the table of random numbers as an example of this distribution. If you plan to cover the exponential distribution (which is an online topic), it is useful to discuss applications of this distribution in queuing (waiting line) theory. In

addition, be sure to point out that Equation (6.10) provides the probability of an arrival in less than or equal to a given amount of time. Be sure to mention that you can use PHStat2 or an Excel function to compute exponential probabilities.

The *Managing Ashland MultiComm Services* case for this chapter relates to the normal distribution. The Digital case involves the normal distribution and the normal probability plot. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve developing normal probability plots.

You can use either Excel functions or the PHStat add-in to compute normal and exponential probabilities and to construct normal probability plots.

Chapter 7

The coverage of the normal distribution in Chapter 6 flows into a discussion of sampling distributions. Point out the fact that the concept of the sampling distribution of a statistic is important for statistical inference. Make sure that students realize that problems in this section will compute probabilities concerning the mean, not concerning individual values. It is helpful to display Figure 7.4 on p. 224 to show how the Central Limit Theorem applies to different shaped populations. A useful classroom or homework exercise involves using PHStat2 or Excel to form sampling distributions. This reinforces the concept of the Central Limit Theorem.

The *Managing Ashland MultiComm Services* case for this chapter relates to the sampling distribution of the mean. The Digital case also involves the sampling distribution of the mean.

You might want to have students experiment with using the Visual Explorations add-in workbook to explore sampling distributions. You can also use either Excel functions, the PHStat add-in, or the Analysis ToolPak to develop sampling distribution simulations.

Chapter 8

You should begin this chapter by reviewing the concept of the sampling distribution covered in Chapter 7. It is important that the students realize that (1) an interval estimate provides a range of values for the estimate of the population parameter, (2) you can never be sure that the interval developed does include the population parameter, and (3) the proportion of intervals that include the population parameter within the interval is equal to the confidence level.

Note that the Using Statistics example for this chapter, which refers to the Ricknel Home Centers is actually a case study that relates to every part of the chapter. This scenario is a good candidate for use as the classroom example demonstrating an application of statistics in accounting. It also enables you to use the DCOVA approach of Define, Collect, Organize, Visualize, and Analyze in the context of statistical inference.

When introducing the t distribution for the confidence interval estimate of the population mean, be sure to point out the differences between the t and normal distributions, the assumption of normality, and the robustness of the procedure. It is useful to display Table E.3 in class to illustrate how to find the critical t value. When developing the confidence interval for the proportion, remind the students that the normal distribution may be used here as an approximation to the binomial distribution as long as the assumption of normality is valid [when $n\pi$ and $n(1 - \pi)$ are at least 5].

Having covered confidence intervals, you can move on to sample size determination by turning the initial question of estimation around, and focusing on the sample size needed for a desired confidence level and width of the interval. In discussing sample size determination for the mean, be sure to focus on the need for an estimate of the standard deviation. When discussing sample size determination for the proportion, be sure to focus on the need for an estimate of the population proportion and the fact that a value of $\pi = 0.5$ can be used in the absence of any other estimate. If time permits, you may wish to discuss the effect of the finite population (this is an Online Topic) on the width of the confidence interval and the sample size needed. Point out that the correction factor should always be used when dealing with a finite population, but will have only a small effect when the sample size is a small proportion of the population size.

Due to the existence of a large number of accounting majors in many business schools, we have included an online section on applications of estimation in auditing. Two applications are included, the estimation of the total, and difference estimation. In estimating the total, point out that estimating the total is similar to estimating the mean, except that you are multiplying both the mean and the width of the confidence interval by the population size. When discussing difference estimation, be sure that the

students realize that all differences of zero must be accounted for in computing the mean difference and the standard deviation of the difference when using Equations (8.8) and (8.9).

Since the formulas for the confidence interval estimates and sample sizes discussed in this chapter are straightforward, using PHStat2 or Workbook can remove much of the tedious nature of these computations.

The *Managing Ashland MultiComm Services* case for this chapter involves developing various confidence intervals and interpreting the results in a marketing context. The Digital case also relates to confidence interval estimation. This chapter marks the first appearance of the Sure Value Convenience Store case which places the student in the role of someone working in the corporate office of a nationwide convenience store franchise. This case will appear in the next three chapters, Chapters 9 – 12, and also in Chapter 15.The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve developing confidence interval estimates.

You can use either Excel functions or the PHStat add-in to construct confidence intervals for means and proportions and to determine the sample size for means and proportions.

Chapter 9

A good way to begin the chapter is to focus on the reasons that hypothesis testing is used. We believe that it is important for students to understand the logic of hypothesis testing before they delve into the details of computing test statistics and making decisions. If you begin with the Using Statistics example concerning the filling of cereal boxes, slowly develop the rationale for the null and alternative hypotheses. Ask the students what conclusion they would reach if a sample revealed a mean of 200 grams (They will all say that something is wrong) and if a sample revealed a mean of 367.99 grams (Almost all will say that the difference between the sample result and what the mean is supposed to be is so small that it must be due to chance). Be sure to make the point that hypothesis testing allows you to take away the decision from a person's subjective judgment, and enables you to make a decision while at the same time quantifying the risks of different types of incorrect decisions. Be sure to go over the meaning of the Type I and Type II errors, and their associated probabilities α and β along with the concept of statistical power (more extensive coverage of the power of a test is included in Section 9.6 which is an Online Topic).

Set up an example of a sampling distribution such as Figure 9.1 on p. 273, and show the regions of rejection and nonrejection. Explain that the sampling distribution and the test statistic involved will change depending on the characteristic being tested. Focus on the situation where σ is unknown if you have numerical data. Emphasize that σ is virtually never known. It is also useful at this point to introduce the concept of the *p*-value approach as an alternative to the classical hypothesis testing approach. Define the *p*-value and use the phrase given in the text "If the *p*-value is low, H_o must go." and the rules for rejecting the null hypothesis and indicate that the *p*-value approach is a natural approach when using Excel, since the *p*-value can be determined by using PHStat, Excel functions, or the Analysis Toolpak.

Once the initial example of hypothesis testing has been developed, you need to focus on the differences between the tests used in various situations. The Chapter 9 summary table is useful for this since it presents a road map for determining which test is used in which circumstance. Be sure to point out that one-tail tests are used when the alternative hypothesis involved is directional (e.g., $\mu > 368$, $\pi < 0.20$). Examine the effect on the results of changing the hypothesized mean or proportion.

The *Managing Ashland MultiComm Services* case, Digital case, and the Sure Value Convenience Store case each involves the use of the one-sample test of hypothesis for the mean.

You can use either Excel functions or the PHStat add-in to carry out the hypothesis tests for means and proportions.

Chapter 10

This chapter discusses tests of hypothesis for the differences between two groups. The chapter begins with t tests for the difference between the means, then covers the Z test for the difference between two proportions, and concludes with the F test for the ratio of two variances.

The first test of hypothesis covered is usually the test for the difference between the means of two groups for independent samples. Point out that the test statistic involves pooling of the sample variances from the two groups and assumes that the population variances are the same for the two groups. Students should be familiar with the t distribution, assuming that the confidence interval estimate for the mean has been previously covered, Point out that a stem-and-leaf display, a boxplot, or a normal probability plot can be used to evaluate the validity of the assumptions of the t test for a given set of data. This allows you to once again use the DCOVA approach of Define, Collect, Organize, Visualize, and Analyze to meet a business objective.

Once the t test has been discussed, you can use the Excel worksheets provided with the Workbook approach, PHStat2, or the Analysis Toolpak to determine the test statistic and p-value. Mention that if the variances are not equal, a separate variance t test can be conducted. The *Consider This* essay is a wonderful example of how the two-sample t test was used to solve a business problem that a student had after she graduated and had taken the introductory statistics course.

At this point, having covered the test for the difference between the means of two independent groups, if you have time in your course, you can discuss a test that examines differences in the means of two paired or matched groups. The key difference is that the focus in this test is on differences between the values in the two groups since the data have been collected from matched pairs or repeated measurements on the same individuals or items. Once the paired t test has been discussed, the Workbook approach, PHStat2, or the Data Analysis tool can be used to determine the test statistic and p-value. You can continue the coverage of differences between two groups by testing for the difference between two proportions. Be sure to review the difference between numerical and categorical data emphasizing the categorical variable used here classifies each observation as of interest or not of interest. Make sure that the students realize that the test for the difference between two proportions follows the normal distribution. A good classroom example involves asking the students if they enjoy shopping for clothing and then classifying the yes and no responses by gender. Since there will often be a difference between males and females, you can then ask the class how to go about determining whether the results are statistically significant.

The F-test for the difference between two variances can be covered next. Be sure to carefully explain that this distribution, unlike the normal and t distributions, is not symmetric and cannot have a

negative value since the statistic is the ratio of two variances. Remind the students that the larger variance is placed in the numerator. Be sure to mention that a boxplot of the two groups and normal probability plots can be used to determine the validity of the assumptions of the F test. This is particularly important here since this test is sensitive to non-normality in the two populations. The Workbook approach, PHStat2, or the Analysis Toolpak can be used to determine the test statistic and p-value. The online section on effect size is particularly appropriate when you have big data with very large sample sizes.

Be aware that the *Managing Ashland MultiComm Services* case since it contains both independent sample and matched sample aspects, involves all the sections of the chapter except the test for the difference between two proportions. The Digital case is based on two independent samples. Thus, only the sections on the t test for independent samples and the F test for the difference between two variances are involved. The Sure Value Convenience Store case now involves a decision between two prices for coffee. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involve the determination of differences between two groups on both numerical and categorical variables.

You can use either Excel functions, the PHStat add-in, or the Analysis ToolPak to carry out the hypothesis tests for the differences between means and variances and for the paired t test. You can also use Excel functions or the PHStat add-in to carry out the hypothesis test for the differences between two proportions.

Chapter 11

If the one-way ANOVA F test for the difference between c means is to be covered in your course, a good way to start is to go back to the sum of squares concept that was originally covered when the variance and standard deviation were introduced in Section 3.2. Explain that in the one-way Analysis of Variance, the sum of squared differences around the overall mean can be divided into two other sums of squares that add up to the total sum of squares. One of these measures differences among the means of the groups and thus is called sum of squares among groups (SSA), while the other measures the differences within the groups and is called the sum of squares within the groups (SSW). Be sure to remind the students that, since the variance is a sum of squares divided by degrees of freedom, a variance among the groups and a variance within the groups can be computed by dividing each sum of squares by the corresponding degrees of freedom. Make the point that the terminology used in the Analysis of Variance for variance is Mean Square, so the variances computed are called MSA, MSW, and MST. This will lead to the development of the F statistic as the ratio of two variances. A useful approach at this point when all formulas are defined, is to set up the ANOVA summary table. Try to minimize the focus on the computations by reminding students that the Analysis of Variance computations can be done using Workbook, PHStat2, or the Analysis Toolpak. It is also useful to show how to obtain the critical F value by either referring to Table E.5 or the Excel results. Be sure to mention the assumptions of the Analysis of Variance and that the boxplot and normal probability plot can be used to evaluate the validity of these assumptions for a given set of data. Levene's test can be used to test for the equality of variances. Workbook or PHStat2 can be used to compute the results for this test.

Once the Analysis of Variance has been covered, if time permits, you will want to determine which means are different. Although many approaches are available, this text uses the Tukey-Kramer procedure that involves the Studentized range statistic shown in Table E.7. Be sure that students compare each paired difference between the means to the critical range. Note that you can use Workbook or PHStat2 to compute Tukey-Kramer multiple comparisons.

The factorial design model in Section 11.2 provides coverage of the two-way analysis of variance with equal number of observations for each combination of factor A and factor B. The approach taken in the text is primarily conceptual since, due to the complexity of the computations, the Analysis ToolPak, or PHStat2 should be used to perform the computations. You should develop the concept of partitioning the total sum of squares (SST) into factor A variation (SSA), factor B variation (SSB), interaction ($SSAB$) and random variation (SSE). Then move on to the development of the ANOVA table displayed in Table 11.6 on p. 367. Perhaps the most difficult concept to teach in the factorial design model is that of interaction. We believe that the display of an interaction graph such as the one shown in Figure 11.13 on

p. 371 is helpful. In addition, showing an example such as Example 11.2 on page 371 is particularly important, so that students observe the lack of parallel lines when significant interaction is present. Be sure to emphasize that the interaction effect is always tested prior to the main effects of A and B, since the interpretation of effects A and B will be affected by whether the interaction is significant.

The randomized block model which is an online topic is an extension of the paired t test in Chapter 10. Slowly go over the partitioning of the total sum of squares (SST) into Among Group variation (SSA), Among Block variation ($SSBL$), and Random variation (SSE). Discuss the ANOVA table and be sure students realize that Excel can be used to perform the computations. Finish this topic with a brief discussion of the relative efficiency of using the randomized block model and the use of the Tukey procedure for multiple comparisons. The online Section 11.4 briefly discusses the difference between the F tests involved when there are fixed and random effects.

The *Managing Ashland MultiComm Services* case for this chapter involves the one way ANOVA and the two-factor factorial design. The Digital case uses the One Way ANOVA. The Sure Value Convenience Store case now involves a decision among four prices for coffee. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Student Survey each involves using the one-way ANOVA to determine whether differences in numerical variables exist among three or more groups

In this chapter, using Workbook is more complicated than in other chapters, so you may want to focus on using the Analysis ToolPak or PHStat2.

Chapter 12

This chapter covers chi-square tests and nonparametric tests. The Using Statistics example concerning hotels relates to the first three sections of the chapter.

If you covered the Z test for the difference between two proportions in Chapter 10, you can return to the example you used there and point out that the chi-square test can be used as an alternative. A good classroom example involves asking the students if they enjoy shopping for clothing (or revisiting Chapter 10's example) and then classifying the yes and no responses by gender. Since there will often be a difference between males and females, you can then ask the class how they might go about determining whether the results are statistically significant. The expected frequencies are computed by finding the mean proportion of items of interest (enjoying shopping) and items not of interest (not enjoying shopping) and multiplying by the sample sizes of males and females respectively. This leads to the computation of the test statistic. Once again as with the case of the normal, t, and F distribution, be sure to set up a picture of the chi-square distribution with its regions of rejection and non-rejection and critical values. In addition, go over the assumptions of the chi square test including the requirement for an expected frequency of at least five in each cell of the 2×2 contingency table.

Now you are ready to extend the chi-square test to more than two groups. Be sure to discuss the fact that with more than two groups, the number of degrees of freedom will change and the requirements for minimum cell expected frequencies will be somewhat less restrictive. If you have time, you can develop the Marascuilo procedure to determine which groups differ.

The discussion of the chi-square test concludes with the test of independence in the r by c table. Be sure to go over the interpretation of the null and alternative hypotheses and how they differ from the situation in which there are only two rows.

If you will be covering the Wilcoxon rank sum test, begin by noting that if the normality assumption was seriously violated, this test would be a good alternative to the t test for the difference between the means of two independent samples. Be sure to discuss the need to rank all the data values without regard to group. Review the fact that the statistic T_1 refers to the sum of the ranks for the group with the smaller sample size. If small samples are involved, be sure to point out that the null hypothesis is rejected if the test statistic T_1 is less than or equal to the lower critical value or greater than or equal to the upper critical value. In addition, explain when the normal approximation can be used. Point out that Workbook or PHStat2 can be used for the Wilcoxon rank sum test.

If the Kruskal-Wallis rank test is to be covered, you can explain that if the assumption of normality has been seriously violated, the Kruskal-Wallis rank test may be a better test procedure than the one-way ANOVA. Once again, be sure to discuss the need to rank all the data values without regard to

group. Go over how to find the critical values of the chi-square statistic using Table E.4. As was the case with the Wilcoxon rank sum test, Workbook or PHStat2 can be used for the Kruskal-Wallis rank test. If you wish, you can briefly discuss the McNemar test which is an online topic. Explain that just like you used the paired-*t* test when you had related samples of numerical data, you use the McNemar test instead of the chi-square test when you have related samples of categorical data. Make sure to state that for two samples of related categorical data, the McNemar test is more powerful than the chi-square test.

You can then move on, if you wish, to the one sample test for the variance which is an online topic. Remind the students that if they are doing a two-tail test, they also need to find the lower critical value in the lower tail of the chi-square distribution.

The *Managing Ashland MultiComm Services* case extends the survey discussed in Chapter 8 to analyze data from contingency tables. The Digital case also involves analyzing various contingency tables. The Sure Value Convenience Store case and the CardioGood Fitness cases involve using the Kruskal-Wallis test instead of the one-way ANOVA, The More Descriptive Choices Follow-up and Clear Mountain State Student Survey cases involve both contingency tables and nonparametric tests.

You can use Workbook or PHStat2.for testing differences between the proportions, tests of independence, and also for the Wilcoxon rank sum test and the Kruskal-Wallis test.

Chapter 13

Regression analysis is probably the most widely used and misused statistical method in business and economics. In an era of easily available statistical and spreadsheet applications, we believe that the best approach is one that focuses on the interpretation of regression results obtained from such applications, the assumptions of regression, how those assumptions can be evaluated, and what can be done if they are violated. Although we also feel that is useful for students to work out at least one example with the aid of a hand calculator, we believe that the focus on hand calculations should be minimized.

A good way to begin the discussion of regression analysis is to focus on developing a model that can provide a better prediction of a variable of interest. The Using Statistics example, which forecasts sales for a chain of clothing stores, is useful for this purpose. You can extend the DCOVA approach discussed earlier by defining the business objective, discussing data collection, and data organization before moving on to the visualization and analysis in this chapter. Be sure to clearly define the dependent variable and the independent variable at this point.

Once the two types of variables have been defined, the example should be introduced. Explain the goal of the analysis and how regression can be useful. Follow this with a scatter plot of the two variables. Before developing the Least Squares method, review the straight-line formula and note that different notation is used in statistics for the intercept and the slope than in mathematics. At this point, you need to develop the concept of how the straight line that best fits the data can be found. One approach involves plotting several lines on a scatter plot and asking the students how they can determine which line fits the data better than any other. This usually leads to a criterion that minimizes the differences between the actual Y value and the value that would be predicted by the regression line. Remind the class that when you computed the mean in Chapter 3, you found out that the sum of the differences around the mean was equal to zero. Tell the class that the regression line in two dimensions is similar to the mean in one dimension, and that the differences between the actual Y value and the value that would be predicted by the regression line will sum to zero. Students at this point, having covered the variance, will usually tell you just to square the differences. At this juncture, you might want to substitute the regression equation for the predicted value, and tell the students that since you are minimizing a quantity, derivatives are used. We discourage you from doing the actual proof, but mentioning derivatives may help some students realize that the calculus they may have learned in mathematics courses is actually used to develop the theory behind the statistical method. The least-squares concepts discussed can be reinforced by using the Visual Explorations in Statistics Simple Linear Regression procedure on p. 436. This procedure produces a scatter plot with an unfitted line of regression and a floating control panel of controls with which to adjust the line. The spinner buttons can be used to change the values of the slope and Y intercept to

change the line of regression. As these values are changed, the difference from the minimum *SSE* changes.

The solution obtained from the Least Squares method allows you to find the slope and *Y* intercept. In this text, since the emphasis is on the interpretation of computer output, focus is now on finding the regression coefficients on the output shown in Figure 13.4 on p. 431. Once this has been done, carefully review the meaning of these regression coefficients in the problem involved. The coefficients can now be used to predict the *Y* value for a given *X* value. Be sure to discuss the problems that occur if you try to extrapolate beyond the range of the *X* variable. Now you can show how to use either the Workbook, the Analysis ToolPak or PHStat2 to obtain the regression output.

Tell the students that now you need to determine the usefulness of the regression model by subdividing the total variation in *Y* into two component parts, explained variation or regression sum of squares (*SSR*) and unexplained variation or error sum of squares (*SSE*). Once the sum of squares has been determined and the coefficient of determination r^2 computed, be sure to focus on the interpretation. Having computed the error sum of squares (*SSE*), the standard error of the estimate can be computed. Make the analogy that the standard error of the estimate has the same relationship to the regression line that the standard deviation had to the arithmetic mean.

The completion of this initial model development phase allows you to begin focusing on the validity of the model fitted. First, go over the assumptions and emphasize the fact that unless the assumptions are evaluated, a correct regression analysis has not been carried out. Reiterate the point that this is one of the things that people are most likely to do incorrectly when they carry out a regression analysis.

Once the assumptions have been discussed, you are ready to begin evaluating whether they have been violated for the model that has been fit. This leads into a discussion of residual analysis. Emphasize that Excel can be used to determine the residuals and that in determining whether there is a pattern in the residuals, you look for gross patterns that are obvious on the plot, *not* minor patterns that are not obvious. Be sure to note that the residual plot can also be used to evaluate the assumption of equal variance along with whether there is a pattern in the residuals over time if the data have been collected in sequential order. Point out that finding no pattern (i.e., a random pattern) means that the model fit is an appropriate one. However, it does not mean that other alternative models involving additional variables should not be considered. Mention also, that a normal probability plot of the residuals can be helpful in determining the validity of the normality assumption. If time permits, the discussion of the Anscombe data in Section 13.9 serves as a strong reinforcement of the importance of residual analysis.

If time is available, you may wish to discuss the Durbin-Watson statistic for autocorrelation. Be sure to discuss how to find the critical values from the table of the *D* statistic and the fact that sometimes the results will be inconclusive.

Once the model fit has been found to be appropriate, inferences in regression can be made. First cover the *t* or *F* test for the slope by referring to the Excel results. Here, the *p*-value approach is usually beneficial. Then, if time permits, you can discuss the confidence interval estimate for the mean and the prediction interval for the individual value.

The *Managing Ashland MultiComm Services* case, the Digital case, and the Brynne case each involves a simple linear regression analysis of a set of data.

To perform simple linear regression, you can use Workbook, the Analysis ToolPak, or PHStat2.

Chapter 14

If time is available in the course, you can now move on to multiple regression. You should point out that Microsoft Excel needs to be used to perform the computations in multiple regression. Once you have the results, you need to focus on the interpretation of the regression coefficients and how the interpretation differs between simple linear regression and multiple regression. Mention the aspects of multiple regression that are similar in interpretation to those in simple regression -- prediction, residual analysis, coefficient of determination, and standard error of the estimate. If possible, the coefficient of partial determination is important to cover in order to be able to evaluate the contribution of each X variable to the model. Remind the students that to compute the coefficient of partial determination, they will need the total sum of squares, the regression sum of squares of the model that includes both variables, and the regression sum of squares for each independent variable given that the other independent variable is already included in the model.

If sufficient time is available, you can move on to the dummy variable model. With dummy variables, be sure to mention that the categories must be coded as 0 and 1. In addition, indicate the importance of determining whether there is an interaction between the dummy variable and the other independent variables. Further discussion can include interaction terms in regression models.

Logistic regression is a topic that has become more important with the growth of business analytics since often there is the need to predict a categorical dependent variable. Explain that unlike Least Squares regression, you are predicting the odds ratio and the probability of an event of interest not a numerical value. You may need to briefly mention natural logarithms and refer students to Appendix A. Make the point that Excel will perform the complex computations involved in logistic regression and all the student will need to do is interpret the results provided.

Both the *Managing Ashland MultiComm Services* case and the Digital case involve developing a multiple regression model that includes dummy variables.

To perform multiple regression, you can use Workbook, the Analysis ToolPak, or PHStat2. To perform logistic regression, you can use Workbook or PHStat2.

Chapter 15

The amount of coverage that can be given to multiple regression in a one-semester course is often limited or not even possible. However, in a two-semester course, additional topics can be covered. Collinearity should at least be mentioned when multiple regression is covered, since it represents one of the problems that can occur with multiple regression models. In terms of the coverage of the quadratic regression model, note that it can be considered as a multiple regression model in which the second independent variable is the square of the first independent variable.

If you are teaching a two-semester course or a course that focuses more on regression, you may be able to cover various topics and also include an introduction to transformations and the capstone topic in regression, model building. This text focuses on the more modern and inclusive approach called best subsets regression that allows the examination of all possible regression models. Excel with PHStat2 includes model building using this approach and provides various statistics for each model including the C_p statistic. If you are using the example presented in Section 15.4, be sure to show the results of all the models. Carefully discuss the steps involved in model building presented in Exhibit 15.1 and the Figure 15.15 roadmap on page 542 for model building.

The Mountain States Potato Company case and the Craybill Instrumentation case provide rich data sets for model building. The Sure Value Convenience Stores case provides an opportunity to fit a quadratic regression model. The Digital case here expands the Digital case presented in Chapter 14 to consider additional variables.

To perform quadratic regression, you can define the quadratic terms using Excel and then use Workbook, the Analysis ToolPak, or PHStat2. To build multiple regression models, you need to use PHStat.

Chapter 16

A good way to begin the discussion of time-series models is to indicate how these models are different from the regression models considered in the previous chapters. In particular, you should focus on the fact that three types of models will be considered, (1) classical models that use least-squares regression in which the independent variable is the time period, (2) moving average and exponential smoothing methods in which no trend is assumed to be present, and (3) autoregressive models in which the independent variable(s) represent values of the dependent variable that have been lagged by one or more time periods.

You may wish to begin by discussing moving average and exponential trend methods. Emphasize the fact that these models are appropriate for smoothing a series when the nature of the trend is unclear or no trend is thought to exist. Point out the fact that the moving average method is not used to forecast into the future and the exponential smoothing method is used to forecast only one period into the future. Be sure to indicate that there is a certain amount of subjectivity involved in any forecast in exponential smoothing since the choice of a weight is somewhat arbitrary. Be sure that students are aware that Excel functions and the Analysis ToolPak can be used to compute moving averages and exponential smoothing results.

You can then move on to the Least Squares trend models and consider three models -- the linear trend model, the curvilinear or quadratic trend model, and the exponential trend model. Several points should be made before beginning the discussion. First, to make the interpretation simpler, the first year of the time series is coded with an X value of zero. Second, remind students that the computations can be done using Workbook, PHStat2, or with the Analysis ToolPak. Third, be sure to indicate that we use the Principle of Parsimony in choosing a model. This principle states that if a simpler model is as good as a more complex one, the simpler model should be chosen. If the exponential trend model is to be covered, remind the students that since the model is linear in the logarithms, antilogarithms of the regression coefficients must be taken in order to express the model in the original units of measurement and to express the predicted Log Y values in the original units for calculating the magnitude of the residuals for model comparison statistics. Point out also that if 1 is subtracted from the antilogarithm of the slope, the rate of growth predicted by the model will be obtained. Reiterate that the exponential model is most appropriate in situations in which the time series is changing at an increasing rate so that the percentage difference from period to period is constant.

An additional approach to forecasting involves autoregressive modeling. Go over the fact that in an autoregressive model, the independent variable is a lagged dependent variable from a previous time period. A first-order autoregressive model has its independent variable as the dependent variable from the

previous time period, while a second-order model has an additional independent variable from a time period that is two periods prior to the one being considered. You might also mention the fact that these autoregressive models are simpler versions of the widely used autoregressive integrated moving average (ARIMA) models.

Now that numerous models have been considered for forecasting purposes, you can turn to the critical issue of choosing the most appropriate model. Emphasize the fact that there are two considerations, the pattern of the residuals and the amount of error in the forecast. Point out the importance of choosing a model that does not have a pattern in the residuals. Also mention that the mean absolute deviation approach is widely used, but that there are other alternative measures that could be considered.

Discussion in the next section focuses on quarterly or monthly data. The approach used in the text involves regression in which dummy variables are used to represent the months or quarters. Use Excel to obtain the results of this complex dummy variable model and slowly go over the interpretation of the intercept, the regression coefficient that refers to time, and the coefficients of the dummy variables. Be sure to note that for monthly data, each dummy variable relates to the multiplier for that month relative to December (for quarterly data each quarter is relative to the fourth quarter).

Index numbers is an Online topic. Begin with the simple price index and then point out that indexes for a group of commodities are common in business. Mention the Consumer Price Index as an example of an aggregate price index. Point out the difference between an unweighted aggregate price index and weighted price indexes that consider the consumption quantities of each commodity.

The *Managing Ashland MultiComm Services* case and the Digital case involve forecasting future sales for monthly data. The Digital case involves a comparison of models for two different sets of data.

To compute moving averages, you use Excel or the Analysis ToolPak. To compute exponentially smoothed values, you use Excel or the Analysis ToolPak. To compute linear, quadratic, exponential trend, autoregressive, and monthly/quarterly models, you use Excel functions followed by Workbook, the Analysis ToolPak, or PHStat2.

Chapter 17

Sections 17.1 and 17.2 represent the culmination of the book. All too often students who complete an introductory business statistics course or courses are faced with a situation in subsequent business courses or new business situations of trying to figure out what statistical methods are appropriate. Whereas, when they were learning methods in a specific chapter, they could assume that their solution lay with the methods covered in the chapter, now things are more open ended.

This chapter provides a roadmap for helping students deal with this situation. The chapter breaks the task down according to whether you are dealing with numerical variables or categorical variables. Then, a series of questions are asked and answers provided for each one of these circumstances.

A good strategy may be to make students aware of Chapter 17 as you proceed through the semester especially when you reach different hypothesis testing procedures. After you complete a chapter (for example, Chapter 10), you can refer to the questions in Chapter 17 so that students will have a better chance of seeing the big picture.

Sections 173, 17.4, and 17.5 on Business analytics are greatly expanded in this edition. If you are teaching a one semester course it is possible that you could integrate some of the descriptive analytics material in Section 17.4 into the discussion of tables and charts. However, a full discussion of the material in Sections 17.3 – 17.5 would be more appropriate in a two semester course or a separate course on business analytics.

You may wish to begin with a discussion of big data and the need for techniques for dealing with big data. Then you can provide examples of the various graphs used in Section 17.1 such as dashboards, gauges, and tree maps.

Section 17. introduces classification and regression trees. Classification trees are used when the dependent variable is categorical. Regression trees are used when the dependent variable is numerical. With classification trees, the dependent variable is broken down according to values of the independent variables. A good approach might be to use the same example that you may have used in logistic regression and then compare the results. With regression trees, you may want to use the same example that you may have used in Chapter 14 or 15 and then compare the results.

Chapter 18 (Online)

In order to fully understand the role of statistics in quality management, the themes of quality management and Six Sigma need to be mentioned. Although students may wonder why this is either being discussed in a statistics class (or why they are reading non-statistical material), they usually enjoy learning about this subject since it provides a rationale for how the statistics course relates to management.

You may want to begin the discussion of control charts by demonstrating the Red Bead experiment. Tell the students that two broad categories of control charts will be considered, attribute charts in Sections 18.2 and 18.4 and variables charts in Section 18.5.

Once this introduction has been completed, an overview of the theory of control charts can be undertaken. Begin by referring to the normal distribution and mention Shewhart's concern about committing errors in determining special causes. Tell the students that setting the limits at three standard deviation units away from the mean is done to insure that there is only a small chance that a stable process will have special cause signals that appear and cannot be explained. Continue the discussion by noting that the integer value 3 made computations simpler in an era prior to the availability of calculators and computers, and that experience has shown that this serves the purpose of keeping false alarms to a minimum.

Once these topics have been discussed, you are ready to begin covering specific control charts. The choice of where to start is an individual one. The simplest approach is to begin with the p chart and refer to the Red Bead experiment and then use other examples such as those shown in Section 18.2. Be sure that students are aware that Excel or PHStat2 can be used to construct the p chart. If time permits, you may wish to also cover the c chart. If you choose to do so, be sure to focus on the fact that the variable involved represents the number of nonconformities per unit (an area of opportunity). The discussion of variables charts should begin with a review of the distinction between attribute and variables charts. Briefly discuss the decisions that need to be made when sample sizes are to be determined and subgroups are to be formed. Be sure to emphasize the fact that variables charts are usually done in pairs, one for the variability and the other for the mean. Emphasize the notion that if the variability chart is out of control, you will be unable to meaningfully interpret the chart for the mean. Again, note that Excel, or PHStat2 can be used to construct both R and $\overline{X}$ charts.

If time allows, you may wish to discuss the topic of process capability. This topic reinforces any previous coverage of the normal distribution. Be sure to go over the distinction between control limits and specification limits and the differences between the various capability statistics.

The themes of quality management and the inclusion of a discussion of the work of Deming and Shewhart allow you to distinguish between common causes of variation and special causes of variation. Perhaps the best way to reinforce this is by conducting the Red Bead experiment (see Section 18.3). This experiment allows the student to see the distinction between the two types of variation. The amount of time spent on Sections 18.8 and 18.9 is a matter of instructor discretion. Some may wish to just list the fourteen points and have students read the section, while others will want to cover the points in detail. Regardless of which approach is taken, in order to emphasize the importance of statistics, the Shewhart-Deming PDSA cycle needs to be mentioned since the study stage typically involves the use of statistical methods. In addition, points 6 (institute training on the job) and 13 (encourage education and self-improvement for everyone) underscore the importance of everyone within an organization being familiar with the basic statistical methods required to manage a process. Students find the experiment of counting *F*s (see Figure 18.9) particularly intriguing since they can't believe that they have messed up such a seemingly easy set of directions.

The importance of statistics can be reinforced by briefly covering the Six Sigma®, an approach that is being used by many large corporations. Go over the DMAIC model and compare it to Deming's 14 points. You can also mention Lean Six Sigma.

The *Harnswell Company Sewing Machine Company* case contains several phases and uses R and $\overline{X}$ charts. The *Managing Ashland MultiComm Services* case also has several phases and uses the p chart and R and $\overline{X}$ charts.

Chapter 19 (Online Chapter)

This chapter expands on the development of the expected value and standard deviation of a probability distribution and Bayes' theorem to develop additional concepts in decision making. In this chapter, all topics refer to the Using Statistics example of the mutual fund and the marketing of organic salad dressings first discussed in Example 19.1. Begin the chapter with the payoff table and the notion of alternative courses of action (some prefer using decision trees). Reiterate that payoffs are often available or can be determined from the profit or cost structure of a problem as shown in problems 19.3 – 19.5. When teaching opportunity loss, be sure to emphasize that you are finding the optimal action and the opportunity loss for each event (row of our payoff table).

The coverage of criteria for decision making covers several criteria including maximax, maximin, expected monetary value, expected opportunity loss, and the return-to-risk ratio. Be sure to remind students that, the expected monetary value and the return to risk ratio may lead to different optimal actions. Note that PHStat2 includes the Decision Making menu selection which provides computations for the various criteria for a given payoff table and event probabilities (or you can use Workbook). It also allows you to demonstrate changes in either the probabilities or the returns and their effect on the results. If time permits, Bayes' theorem can be used to revise probabilities based on sample information and the utility concept can be introduced.

Chapter 1

1.1   (a)   The type of beverage sold yields categorical or "qualitative" responses rather than numerical responses. Each beverage type represents a separate category.

        (b)   The type of beverage category expresses no order or ranking.

1.2   Business size represents a categorical variable because each size represents a particular category. Because of the different sizes, order is implied, but this variable includes no information about the quantity of differences among the three sizes.

1.3   (a)   The time it takes to download a video from the Internet is a continuous numerical or "quantitative" variable because time can have any value from 0 to any reasonable unit of time

        (b)   The time it takes to download a video from the Internet is a ratio-scaled variable because it is an ordered scale that includes a true zero point.

1.4   (a)   The number of cellphones is a numerical variable that is discrete because the outcome is a count.

        (b)   Monthly data usage is a numerical variable that is continuous because any value within a range of values can occur.

        (c)   Number of text messages exchanged per month is a numerical variable that is discrete because the outcome is a count.

        (d)   Voice usage per month is a numerical variable that is continuous because any value within a range of values can occur.

        (e)   Whether a cellphone is used for streaming video is a categorical variable because the answer can be only yes or no.

1.5   (a)   numerical, ratio

        (b)   numerical, ratio

        (c)   categorical, nominal

        (d)   categorical, nominal

1.6   (a)   Categorical, nominal scale

        (b)   Numerical, continuous, ratio scale

        (c)   Categorical, nominal scale

        (d)   Numerical, discrete, ratio scale

        (e)   Categorical, nominal scale

1.7   (a)   numerical, ratio scale, continuous

        (b)   categorical, nominal scale

        (c)   categorical, nominal scale

        (d)   numerical, ratio scale, discrete

1.8   (a)   numerical, continuous, ratio scale

        (b)   numerical, discrete, ratio scale

        (c)   numerical, continuous, ratio scale

        (d)   categorical, nominal scale

1.9   (a)   Income may be considered discrete if we "count" our money. It may be considered
                continuous if we "measure" our money; we are only limited by the way a country's
                monetary system treats its currency.
        (b)   The first format would provide more information because it includes a ratio scale value
                while the second measure would only include a range of values for each choice category.

1.10   The underlying variable, ability of the students, may be continuous, but the measuring device, the
        test, does not have enough precision to distinguish between the two students.

1.11   (a)   The population is "all working women from the metropolitan area." A systematic or
                random sample could be taken of women from the metropolitan area. The director might
                wish to collect both numerical and categorical data.
        (b)   Three categorical questions might be occupation, marital status, type of clothing.
                Numerical questions might be age, average monthly hours shopping for clothing, income.

1.12   (a)   Data distributed by an organization or individual.
        (b)   The American Community Survey is based on a sample.

1.13   The answer depends on the specific story.

1.14   The answer depends on the specific story.

1.15   The transportation engineers and planners should use primary data collected through an
        observational study of the driving characteristics of drivers over the course of a month.

1.16   The information presented there is based mainly on a mixture of data distributed by an
        organization and data collected by ongoing business activities.

1.17   (a)   001
        (b)   040
        (c)   902

1.18   Sample without replacement: Read from left to right in 3-digit sequences and continue unfinished
        sequences from end of row to beginning of next row.
        Row 05: 338 505 855 551 438 855 077 186 579 488 767 833 170
        Rows 05–06: 897
        Row 06: 340 033 648 847 204 334 639 193 639 411 095 924
        Rows 06–07: 707
        Row 07: 054 329 776 100 871 007 255 980 646 886 823 920 461
        Row 08: 893 829 380 900 796 959 453 410 181 277 660 908 887
        Rows 08–09: 237
        Row 09: 818 721 426 714 050 785 223 801 670 353 362 449
        Rows 09–10: 406
        Note: All sequences above 902 and duplicates are discarded.

1.19   (a)   Row 29: 12 47 83 76 22 99 65 93 10 65 83 61 36 98 89 58 86 92 71
                Note: All sequences above 93 and all repeating sequences are discarded.
        (b)   Row 29: 12 47 83 76 22 99 65 93 10 65 83 61 36 98 89 58 86
                Note: All sequences above 93 are discarded. Elements 65 and 83 are repeated.

1.20   A simple random sample would be less practical for personal interviews because of travel costs (unless interviewees are paid to attend a central interviewing location).

1.21   This is a probability sample because the selection is based on chance. It is not a simple random sample because A is more likely to be selected than B or C.

1.22   Here all members of the population are equally likely to be selected and the sample selection mechanism is based on chance. But not every sample of size 2 has the same chance of being selected. For example the sample "B and C" is impossible.

1.23   (a)   Since a complete roster of full-time students exists, a simple random sample of 200 students could be taken. If student satisfaction with the quality of campus life randomly fluctuates across the student body, a systematic 1-in-20 sample could also be taken from the population frame. If student satisfaction with the quality of life may differ by gender and by experience/class level, a stratified sample using eight strata, female freshmen through female seniors and male freshmen through male seniors, could be selected. If student satisfaction with the quality of life is thought to fluctuate as much within clusters as between them, a cluster sample could be taken.

        (b)   A simple random sample is one of the simplest to select. The population frame is the registrar's file of 4,000 student names.

        (c)   A systematic sample is easier to select by hand from the registrar's records than a simple random sample, since an initial person at random is selected and then every 20th person thereafter would be sampled. The systematic sample would have the additional benefit that the alphabetic distribution of sampled students' names would be more comparable to the alphabetic distribution of student names in the campus population.

        (d)   If rosters by gender and class designations are readily available, a stratified sample should be taken. Since student satisfaction with the quality of life may indeed differ by gender and class level, the use of a stratified sampling design will not only ensure all strata are represented in the sample, it will also generate a more representative sample and produce estimates of the population parameter that have greater precision.

        (e)   If all 4,000 full-time students reside in one of 10 on-campus residence halls which fully integrate students by gender and by class, a cluster sample should be taken. A cluster could be defined as an entire residence hall, and the students of a single randomly selected residence hall could be sampled. Since each dormitory has 400 students, a systematic sample of 200 students can then be selected from the chosen cluster of 400 students. Alternately, a cluster could be defined as a floor of one of the 10 dormitories. Suppose there are four floors in each dormitory with 100 students on each floor. Two floors could be randomly sampled to produce the required 200 student sample. Selection of an entire dormitory may make distribution and collection of the survey easier to accomplish. In contrast, if there is some variable other than gender or class that differs across dormitories, sampling by floor may produce a more representative sample.

1.24   (a)   Row 16: 2323 6737 5131 8888 1718 0654 6832 4647 6510 4877
                Row 17: 4579 4269 2615 1308 2455 7830 5550 5852 5514 7182
                Row 18: 0989 3205 0514 2256 8514 4642 7567 8896 2977 8822
                Row 19: 5438 2745 9891 4991 4523 6847 9276 8646 1628 3554
                Row 20: 9475 0899 2337 0892 0048 8033 6945 9826 9403 6858
                Row 21: 7029 7341 3553 1403 3340 4205 0823 4144 1048 2949
                Row 22: 8515 7479 5432 9792 6575 5760 0408 8112 2507 3742
                Row 23: 1110 0023 4012 8607 4697 9664 4894 3928 7072 5815
                Row 24: 3687 1507 7530 5925 7143 1738 1688 5625 8533 5041
                Row 25: 2391 3483 5763 3081 6090 5169 0546
                Note: All sequences above 5000 are discarded. There were no repeating sequences.

        (b)   089   189   289   389   489   589   689   789   889   989
                1089 1189 1289 1389 1489 1589 1689 1789 1889 1989
                2089 2189 2289 2389 2489 2589 2689 2789 2889 2989
                3089 3189 3289 3389 3489 3589 3689 3789 3889 3989
                4089 4189 4289 4389 4489 4589 4689 4789 4889 4989

        (c)   With the single exception of invoice #0989, the invoices selected in the simple random
                sample are not the same as those selected in the systematic sample. It would be highly
                unlikely that a random process would select the same units as a systematic process.

1.25   (a)   A stratified sample should be taken so that each of the three strata will be proportionately
                represented.
        (b)   The number of observations in each of the three strata out of the total of 100 should
                reflect the proportion of the three categories in the customer database. For example,
                500/1000 = 50% so 50% of 100 = 50 customers should be selected from the potential
                customers; similarly, 300/1000 = 30% so 30 customers should be selected from those
                who have purchased once, and 200/1000 = 20% so 20 customers from the repeat buyers.
        (c)   It is not simple random sampling because, unlike the simple random sampling, it ensures
                proportionate representation across the entire population.

1.26   (a)   For the third value, Apple is spelled incorrectly. The twelfth value should be Blackberry
                not Blueberry. The fifteenth value, APPLE, may lead to an irregularity. The eighteenth
                value should be Samsung not Samsun.
        (b)   This list contains 19 names, where one would expect to find 20 names.

1.27   Only the second value, 2.7MB, contains units and the eighth value, 1,079, might be confused with
        1, 79.

1.28   (a)   The times for each of the hotels would be arranged in separate columns.
        (b)   The hotel names would be in one column and the times would be in a second column.

1.29   A recoded variable PriceLevel could be defined, assigning the value Budget for hotels with
        budget-priced rooms, Moderate for hotels with moderate-priced rooms, and Deluxe for hotels
        with deluxe-priced rooms.

1.30   Before accepting the results of a survey of college students, you might want to know, for
        example:
        Who funded the survey? Why was it conducted? What was the population from which the sample
        was selected? What sampling design was used? What mode of response was used: a personal
        interview, a telephone interview, or a mail survey? Were interviewers trained?

1.30   Were survey questions field-tested? What questions were asked? Were they clear, accurate,
cont.   unbiased, valid? What operational definition of "vast majority" was used? What was the response
       rate? What was the sample size?

1.31   (a)   Possible coverage error: Only employees in a specific division of the company were
               sampled.
       (b)   Possible nonresponse error: No attempt is made to contact nonrespondents to urge them
               to complete the evaluation of job satisfaction.
       (c)   Possible sampling error: The sample statistics obtained from the sample will not be equal
               to the parameters of interest in the population.
       (d)   Possible measurement error: Ambiguous wording in questions asked on the
               questionnaire.

1.32   Coverage error could result if bank executives are systematically excluded from the population
       thereby not allowing them to be part of any sample that is used to generate the results. This could
       lead to selection bias. Non-response error that results in non-response bias could result if not all
       bank executives who were selected for inclusion in the sample are contacted even after multiple
       attempts to do so. In this case, data that was desired and necessary for inclusion in the sample
       would then not be present. Sampling error reflects the variability in outcomes when taking
       different samples. Sampling error is unavoidable. One can obtain an impression of the size of
       the sampling error by creating interval estimates. Measurement error could arise if the bank
       executives self-report results or if the methods of reporting are not standardized, i.e. if questions
       are not asked in the same manner from respondent to respondent, or if those conducting the
       survey do not do so in a consistent manner.

1.33   Before accepting the results of the survey, you might want to know, for example:
       Who funded the survey? Why was it conducted? What was the population from which the
       sample was selected? What sampling design was used? What mode of response was used: a
       personal interview, a telephone interview, or a mail survey? Were interviewers trained? Were
       survey questions field-tested? What questions were asked? Were they clear, accurate, unbiased,
       valid? What was the response rate? What was the margin of error? What was the sample size?
       What frame was used?

1.34   Before accepting the results of the survey, you might want to know, for example:
       Who funded the survey? Why was it conducted? What was the population from which the sample
       was selected? What sampling design was used? What mode of response was used: a personal
       interview, a telephone interview, or a mail survey? Were interviewers trained? Were survey
       questions field-tested? What questions were asked? Were they clear, accurate, unbiased, valid?
       What was the response rate? What was the margin of error? What was the sample size? What
       frame was used?

1.35   A population contains all the items of interest whereas a sample contains only a portion of the
       items in the population.

1.36   A statistic is a summary measure describing a sample whereas a parameter is a summary measure
       describing an entire population.

1.37   Categorical random variables yield categorical responses such as yes or no answers. Numerical
       random variables yield numerical responses such as your height in inches.

1.38   Discrete random variables produce numerical responses that arise from a counting process. Continuous random variables produce numerical responses that arise from a measuring process.

1.39   Both nominal scaled and ordinal scaled variables are categorical variables but no ranking is implied in nominal scaled variable such as male or female while ranking is implied in ordinal scaled variable such as a student's grade of A, B, C, D and F.

1.40   Both interval scaled and ratio scaled variables are numerical variables in which the difference between measurements is meaningful but an interval scaled variable does not involve a true zero such as standardized exam scores while a ratio scaled variable involves a true zero such as height.

1.41   Items or individuals in a probability sampling are selected based on known probabilities while items or individuals in a nonprobability samplings are selected without knowing their probabilities of selection.

1.42   Missing values are values that were not collected for a variable. Outliers are values that seem excessively different from most of the other values

1.43   In unstacked arrangements, separate numerical variables are created for each group in the data. For example, you might create a variable for the weights of men and a second variable for the weights of women. In stacked arrangements, a single numerical variable is paired with a categorical variable that represents the categories. For example, all weights would be in one variable, with a categorical variable indicating male or female.

1.44   Coverage error is error generated due to an improperly or inappropriately framed population which can result in a sample that may not be representative of the population that one wishes to study. Non-response error is error generated due to members of a chosen sample not being contacted even after repeated attempts so that information that should be provided is missing.

1.45   Sampling error results from the variability of outcomes of different samples. This sample to sample variation is inevitably connected to the sampling process. Measurement error is error that results from either self-reported data or data that is collected in an inconsistent manner by those who are responsible for collecting and summarizing the desired information.

1.46   Microsoft Excel:
This product features a spreadsheet-based interface that allows users to organize, calculate, and organize data. Excel also contains many statistical functions to assist in the description of a dataset. Excel can be used to develop worksheets and workbooks to calculate a variety of statistics including introductory and advanced statistics. Excel also includes interactive tools to create graphs, charts, and pivot tables. Excel can be used to summarize data to better understand a population of interest, compare across groups, predict outcomes, and to develop forecasting models. These capabilities represent those that are generally relevant to the current course.

Excel also includes many other statistical capabilities that can be further explored on the Microsoft Office Excel official website.

1.47   (a)   The population of interest include banking executives representing institutions of various sizes and U.S. geographic locations.
        (b)   The collected sample includes 163 banking executives from institutions of various sizes and U.S. geographic locations.

1.47   (c)   A parameter of interest is the percentage of the population of banking executives that
cont.   identify customer experience initiatives as an area where increased spending is expected.
        (d)   A statistic used to the estimate the parameter in (c) is the percentage of the 163 banking
                executives included in the sample who identify customer experience initiatives as an area
                where increased spending is expected. In this case, the statistic is 55%.

1.48   The answers are based on an article titled "U.S. Satisfaction Still Running at Improved Level"
        and written by Lydia Saad (August 15, 2018). The article is located on the following site:
        https://news.gallup.com/poll/240911/satisfaction-running-improved-
        level.aspx?g_source=link_NEWSV9&g_medium=NEWSFEED&g_campaign=item_&g_content
        =U.S.%2520Satisfaction%2520Still%2520Running%2520at%2520Improved%2520Level
        (a)   The population of interest includes all individuals aged 18 and older who live within the
                50 U.S. states and the District of Columbia.
        (b)   The collected sample includes a random sample of 1,024 individuals aged 18 and older
                who live within the 50 U.S. states and the District of Columbia.
        (c)   A parameter of interest is the percentage of the population of individuals aged 18 and
                older and live within the 50 U.S. states and the District of Columbia who are satisfied
                with the direction of the U.S.
        (d)   A statistic used to the estimate the parameter in (c) is the percentage of the 1,024
                individuals included in the sample. In this case, the statistic is 36%.

1.49   The answers were based on information obtained from the following site:
        (a)   The population of interest is U.S. CEOs
        (b)   The sample included 1,000 U.S. CEOs.
        (c)   A parameter of interest would be the percentage of CEOs among the population of
                interest that believe that AI will significantly change the way they will do business in the
                next five years.
        (d)   The statistic used to estimate the parameter in (c) is the percentage of CEOs among the
                1,000 CEOs included in the sample who believe that AI will significantly change the way
                they will do business in the next five years. In this case, the statistic is 80% agree with
                this statement

1.50   (a)   One variable collected with the American Community Survey is marital status with the
                following possible responses: now married, widowed, divorced, separated, and never
                married.
        (b)   The variable in (a) represents a categorical variable.
        (c)   Because the variable in (a) is a categorical, this question is not applicable. If one had
                chosen age in years from the American Community Survey as the variable, the answer to
                (c) would be discrete.

1.51   Answers will vary depending on the specific sample survey used. The below answers were based
        on the sample survey located at: bit.ly/21qjI6F

        (a)   An example of a categorical variable included in the survey is gender with male or
                female as possible answers.
        (b)   An example of a numerical variable included in the survey would be the number of phone
                calls made or received from or to ones direct supervisor in an average week.

1.52   (a)   The population of interest consisted of 10,000 benefited employees of the University of Utah.
        (b)   The sample consisted of 3,095 employees of the University of Utah.

1.52   (c)   Gender, marital status, and employment category represent categorical variables. Age in years,
cont.   education level in years completed, and household income represent numerical variables.

1.53   (a)   Key social media platforms used represents a categorical variable. The frequency of
               social media usage represents a discrete numerical variable. Demographics of key social
               media platform users represent categorical variables.
        (b)   1. Which of the following is your preferred social media platform: YouTube, Facebook,
               or Twitter?
               2. What time of the day do you spend the most amount of time using social media:
               morning, afternoon, or evening?
               3. Please indicate your ethnicity?
               4. Which of the following do you most often use to access social media: mobile device,
               laptop computer, desktop computer, other device?
               5. Please indicate whether you are a home owner: Yes or No?
        (c)   1. For the past week, how many hours did you spend using social media?
               2. Please indicate your current age in years.
               3. What was your annual income this past year?
               4. Currently, how many friends have you accepted on Facebook?
               5. Currently, how many twitter followers do you have?